DOCUMENT RESUME

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ABSTRACT

This document contains test items to measure the job skills of electromechanical technicians. Questions are organized in four sections that cover the following topics: (1) shop math; (2) electricity and electronics; (3) mechanics and machining; and (4) plumbing, heating, ventilation and air conditioning, and welding skills. Questions call for short answers or problem solving. For each page of questions, respondents are requested to rate their knowledge level, from one ("could use a refresher class") to 5 ("have mastered this area"). The results of the skills questionnaire can be used to determine where a company should focus future training and development efforts. (KC)

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ED 391 902

# Electromechanical Technician

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## Skills Questionnaire

Print Name _____ Shift _____

Today's Date _____

Signature _____ Supervisor _____

CE020759



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# The Onan Skills Questionnaire

Welcome to the Onan Electromechanical Technician skills questionnaire.

You are completing this questionnaire to determine where Onan should focus future training and development efforts.

You will find questions on:

- Shop math
- Electricity
- Electronics
- Welding
- Plumbing
- HVAC
- Machining
- Mechanics

This questionaire package is your property. This package will not be collected by Onan.

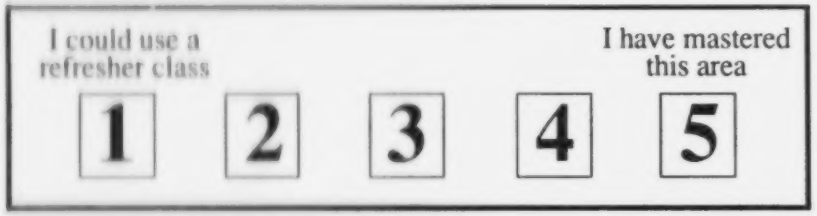
# Tabulating the Questionnaire: Page 1

There are four sections in the questionnaire:

1. Shop math
2. Electricity and electronics
3. Mechanics and machining
4. Plumbing, HVAC and welding skills

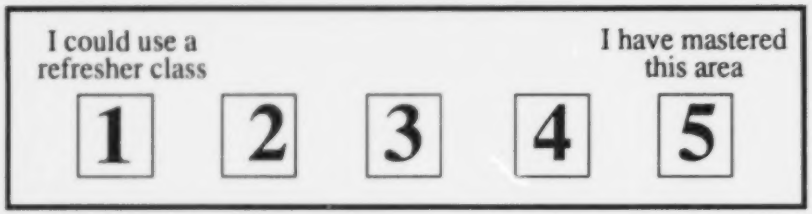
On each page, you will be asked to complete questions or to evaluate your understanding of certain skills.

You will find boxes like the one illustrated below. It is your job to complete each box to the best of your ability and to tabulate your scores in each section. Your shift supervisor will lead discussions about the scores of your questionnaires to determine where training is needed.



# Tabulating the Questionnaire: Page 2

***How do you complete the box on each page?***




1 = You would attend a training class on this subject because you need the information to do your job more effectively.

2 = You think training on this subject would be helpful for some of your co-workers.

3 = A course in this subject may or may not be necessary.

4 = You probably wouldn't attend a training class on this subject because you have a working knowledge in that area.

5 = You have the skills and knowledge to ***teach*** this class.

# Section 1: Shop Math Skills

# Math Skills

| Add | Add | Subtract | Subtract |
|---|---|---|---|
| 13 | 47111 | 156 | 1,564 |
| 33 | 3134 | – 34 | – 198 |
| 125 | 256 | | |
| 109 | 9989 | | |

I could use a refresher class

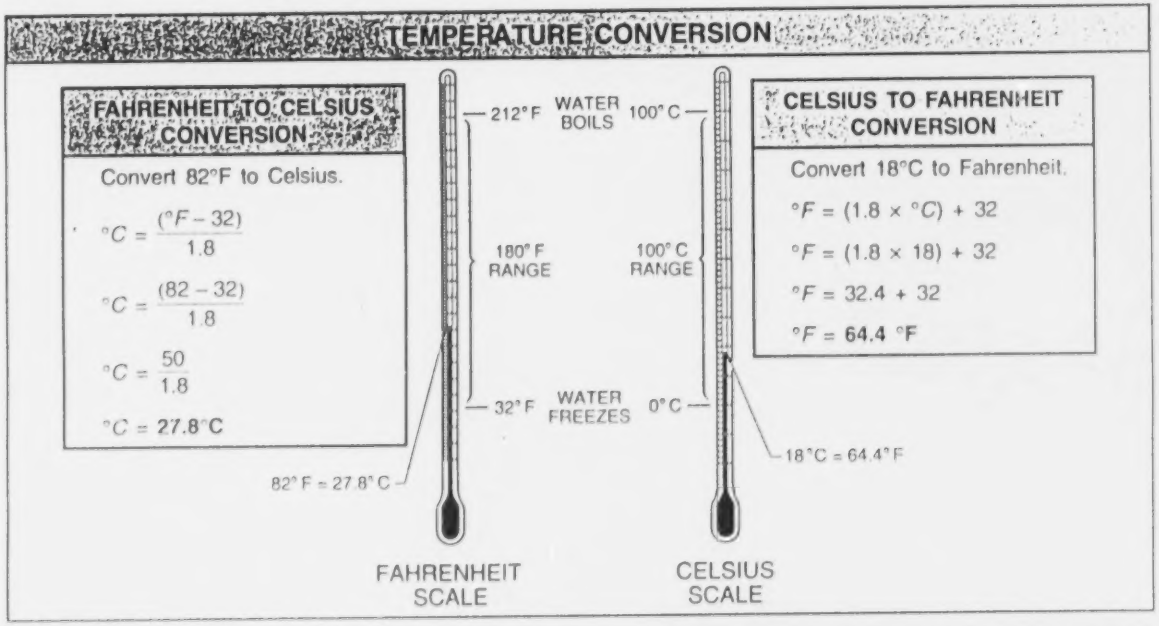
1 2 3 4 5

I have mastered this area

# Math Skills

*Do you understand how to convert english to metric and metric to english: temperature, length, area and volume? See the next page for more conversions.*

What is 86° F in °C? _____


TEMPERATURE CONVERSION
FAHRENHEIT TO CELSIUS CONVERSION
Convert 82°F to Celsius.
°C = (°F − 32) / 1.8
°C = (82 − 32) / 1.8
°C = 50 / 1.8
°C = 27.8°C
212° F WATER BOILS
180° F RANGE
32° F WATER FREEZES
100° C
100° C RANGE
0° C
82° F = 27.8° C
18° C = 64.4° F
FAHRENHEIT SCALE
CELSIUS SCALE
CELSIUS TO FAHRENHEIT CONVERSION
Convert 18°C to Fahrenheit.
°F = (1.8 × °C) + 32
°F = (1.8 × 18) + 32
°F = 32.4 + 32
°F = 64.4 °F

I could use a refresher class

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

I have mastered this area

**Commonly Used English-Metric Equivalents**

| English to Metric | Metric to English |
|---|---|
| **LENGTH** | |
| 1 in = 25.4 mm (millimeters) | 1 mm = 0.0394 in |
| 1 in = 2.54 cm (centimeters) | 1 cm = 0.394 in |
| 1 ft = 304.8 mm | 1 cm = 0.033 ft |
| 1 ft = 30.48 cm | 1 m = 39.37 in |
| 1 ft = 0.305 m (meter) | 1 m = 3.28 ft |
| 1 yd = 0.915 m | 1 km = 3280.83 ft |
| 1 mi = 1609.34 m | 1 km = 0.621 mi (mile) |
| 1 mi = 1.609 km (kilometers) | |
| **AREA** | |
| 1 sq in = 645.16 sq mm ($mm^2$) | 1 sq cm = 0.155 sq in |
| 1 sq in = 6.45 sq cm ($cm^2$) | 1 sq cm = 0.0011 sq ft |
| 1 sq ft = 929.03 sq cm ($cm^2$) | 1 sq m = 10.764 sq ft |
| 1 sq ft = 0.093 sq m ($m^2$) | 1 sq m = 1.2 sq yd (yards) |
| **VOLUME** | |
| 1 cu in = 16.38 cc ($cm^3$) | 1 cc = 0.061 cu in |
| 1 cu in = 0.016 liter (L or l) | 1 L = 61.02 cu in |
| 1 cu ft = 28.32 (L or l) | 1 L = 0.035 cu ft |
| 1 liquid qt = 0.9475 (L or l) | 1 L = 1.056 liquid qt |
| 1 liquid gal = 3.79 (L or l) | 1 L = 0.264 liquid gal |

# Math Skills

Multiply

93
X 12

_____

Solve through Multiplication

A machine screw has 8 threads to the inch. How many threads are there in a threaded piece 7 inches long?

_____

Solve through Division

An Onan machine shop supervisor spends $2,368 to buy tools. Each tools costs an average of $16. How many tools can be bought?

_____

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Math Skills

Solve the problems

(4) (6) - 2 =

(4) (6-2) =

(4/5) (5/8) (3) + 3-1 =

(4/5) (5/8) (3+3-1) =

$3^4$ =

$10^5$ =

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Math Skills

Which is greater?

.015 or -.215

Which is greater?

-.024 or -.026

A screw 4 inches long has 52 threads.

a. How many threads per inch are there? _____

b. What is the pitch? _____

A screw is 3 1/2 inches long and has 56 threads.

a. Find the number of threads per inch. _____

b. Find the pitch of the screw. _____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Math Skills

Subtract

$$\begin{array}{rr} & 56.9 \\ - & 3.6 \\ \hline \end{array}$$

Multiply

$$\begin{array}{rr} & 3.4567 \\ \times & 3.9876 \\ \hline \end{array}$$

Subtract

$$\begin{array}{rr} & 9883.456 \\ - & 298.179 \\ \hline \end{array}$$

Divide

$$5.35 \overline{)\,29.425}$$

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Math Skills

Express theses subdivisions of an inch in machinists' terms.

Two problems have been done for you.

.000001 Millionth

.00001 _____

.0001 _____

.001 _____

.01 Hundredth

Convert the fraction 7/8 to a decimal number _____

Convert .75 to a fraction _____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Section 2: Electrical & Electronics Skills

# Electricity & Electronics

*Define the following terms:*

Volt

Ampere

Ohm

Explain the relationship between the three terms above.

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Define the following terms:*

Watts

_____

_____

*How many watts in a...*

Kilowatt _____

Megawatt _____

Milliwatt _____

Microwatt _____

3 volts X 120 amps = 360 watts

? volts X 6 amps = 360 watts

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Answer the following questions*

If the ends of a 1000 ft. length of No. 10 copper wire are connected to a 1 volt source of electricity, 1 amp will flow through the wire. Why?

Define Ohm's Law

How would you determine the number of amperes in a circuit?

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

A wiring device is a component that carries current but does not consume it. List four types of wiring devices.

_____

_____

A fitting is an accessory that is intended to perform a mechanical rather than an electrical function. List three types of fittings.

_____

_____

*Define the following terms:*

Resistors

Conductors

Insulators

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electrical Symbols

*Refer to the next two pages and complete the boxes.*

I can identify the electrical symbols shown on page 14.

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

I successfully matched the 20 symbols found on the electrical working drawings shown on page 15.

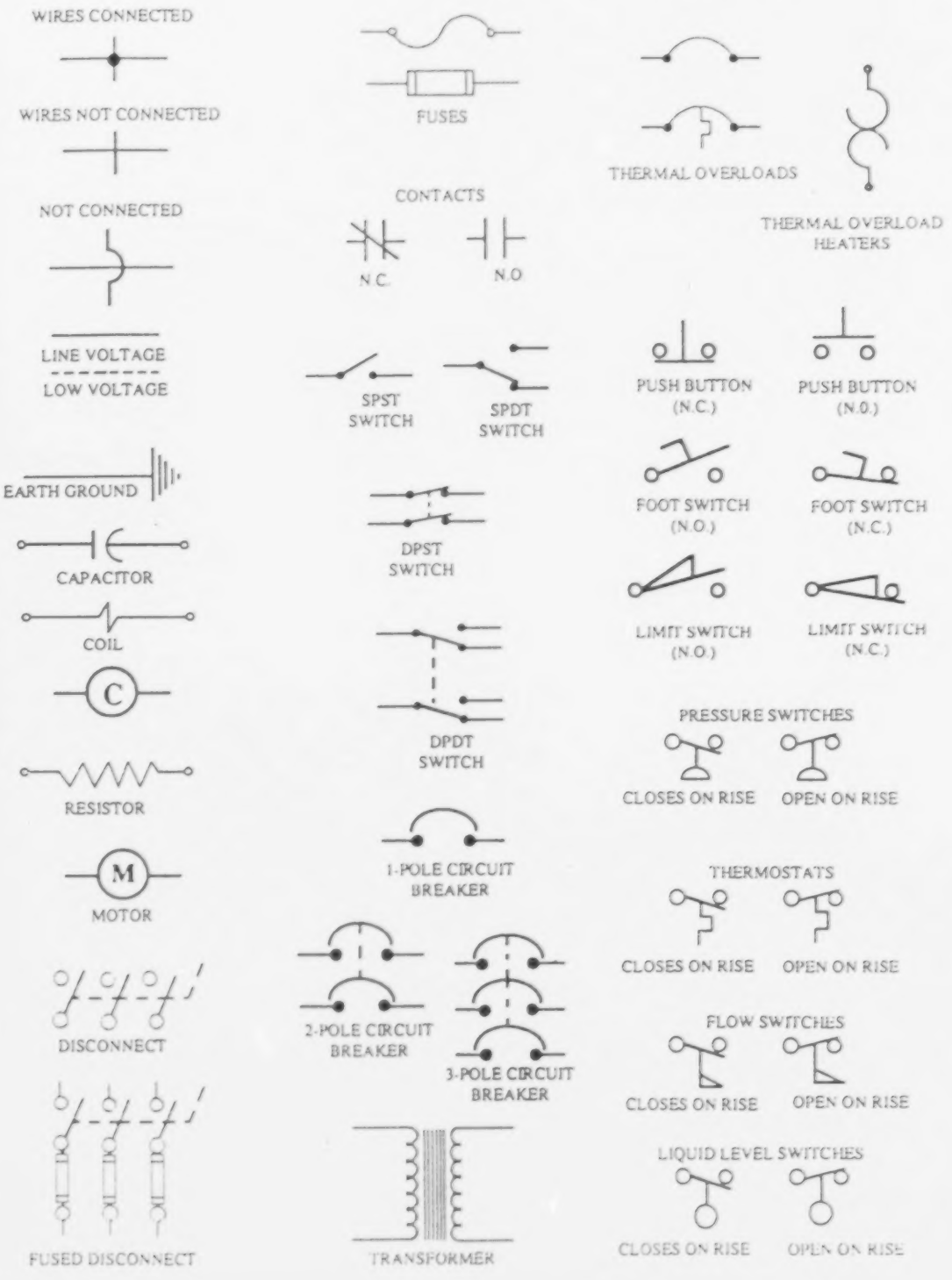
| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

Shown below are 20 symbols commonly found on electrical working drawings. In the space provided, place the letter corresponding to the correct answer found in the list.

| | | | |
|---|---|---|---|
| 1. | | _____ | A. Fluorescent fixture |
| 2. | | _____ | B. Incandescent fixture, recessed |
| 3. | | _____ | C. Incandescent fixture, wall-mounted |
| 4. | | _____ | D. Exit light, surface- or pendant-mounted |
| 5. |  | _____ | E. Exit light, wall-mounted |
| 6. |  | _____ | F. Indicates fixture type |
| 7. | | _____ | G. Receptacle, duplex-grounded |
| 8. | | _____ | H. Receptacle, weatherproof |
| 9. | | _____ | I. Combination switch and receptacle |
| 10. | | _____ | J. Receptacle, floor-type |
| 11. | | _____ | K. Switch, three-way |
| 12. | | _____ | L. Light or power panel |
| 13. | | _____ | M. Disconnect switch |
| 14. | | _____ | N. Conduit, exposed |
| 15. | | _____ | O. Home run to panel |
| 16. | | _____ | P. Telephone conduit |
| 17. | | _____ | Q. Fan coil-unit connection |
| 18. | | _____ | R. Fire-alarm striking station |
| 19. |  | _____ | S. Smoke detector |
| 20. | | _____ | T. Telephone outlet, wall |

15

# ELECTRICAL SYMBOLS




14



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# Electricity & Electronics

*Define the following terms:*

Controls

Components

Circuits

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Electricity & Electronics

*Answer the following questions:*

What is a short circuit and how would you troubleshoot it?

_____

_____

_____

What is a ground fault and how would you troubleshoot it?

_____

_____

_____

What problems can a loose electrical connection cause?

_____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Answer the following questions:*

Define ac?

Define dc?

What are the similarities and differences between ac and dc?

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electrical Troubleshooting

The commutator is a vital part of every dc machine. How well a machine performs depends largely on how well the commutator is maintained.

Below are possible causes of commutator damage. List suggested corrections.

1. Excessive current load on the machine
Correction:

2. Electrical adjustment is off
Correction:

3. Wrong brush grade
Correction:

4. Rough commutator surface
Correction:

5. Contaminated atmosphere
Correction:

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Electrical Troubleshooting

You will find possible causes for a motor running hot on an ac synchronous motor. List suggested corrections.

1. Mechanical overload
Correction:

2. Improper vent
Correction:

3. Shorted or open coils in motor
Correction:

4. High line voltage
Correction:

5. Stator grounded
Correction:

6. Incorrect field current
Correction:

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electrical Troubleshooting

You will find possible causes why an ac motor will not start.
List suggested corrections.

1. No power supply
Correction:

2. Mechanical overload
Correction:

3. Improper brush - armature contact
Correction:

4. Field coil open
Correction:

5. Armature circuit open
Correction:

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Explain the purpose of the following test equipment. What does it measure?*

Multirange meter _____

_____

Oscilloscope _____

_____

Audio frequency signal generator _____

_____

Logic probe _____

_____

Frequency meter _____

_____

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Electricity & Electronics

*Explain the following basic motor control functions as they relate to equipment:*

Start _____

_____

Stop _____

_____

Running _____

_____

Speed Regulation _____

_____

Protection _____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Answer the following questions:*

Why should electronic equipment be deenergized before servicing?

_____

_____

How should electronic equipment be cleaned?

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Below you will find an elementary diagram of a pushbutton motor control.*

1. What is the purpose of a pushbutton motor control circuit.

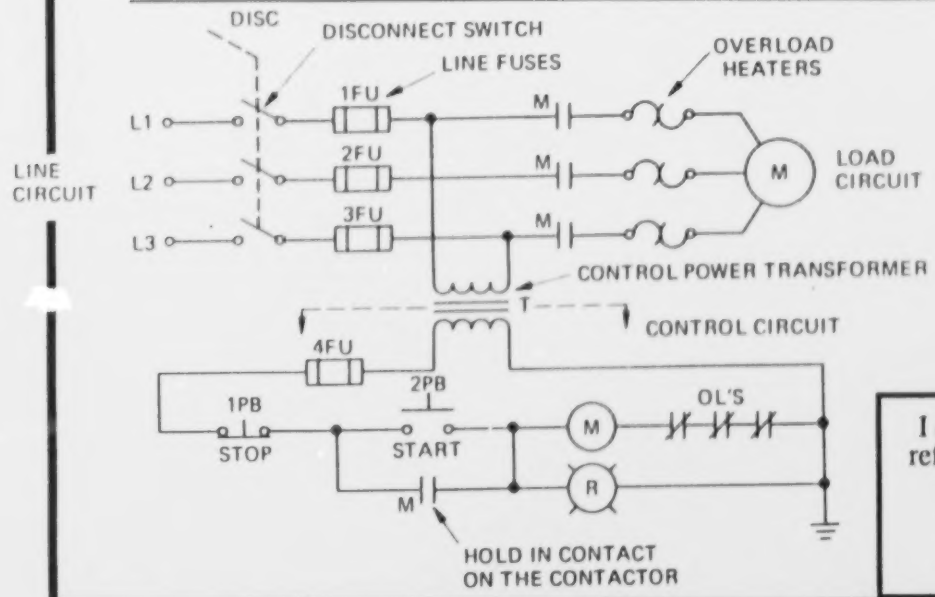
_____

_____

2. Explain one pushbutton motor control circuit found at Onan.

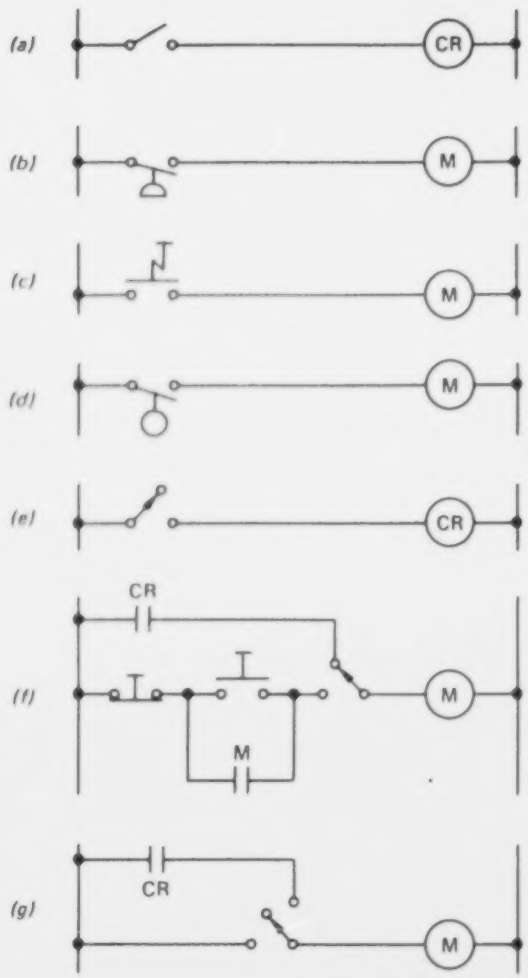
_____

_____




I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|




*These are typical methods of industrial control: parts f and g represent three-wire control, the others, two-wire control.*

Explain the purpose of a motor control center _____

_____

_____

Identify the location and purpose of a motor control center at the Fridley plant _____

_____

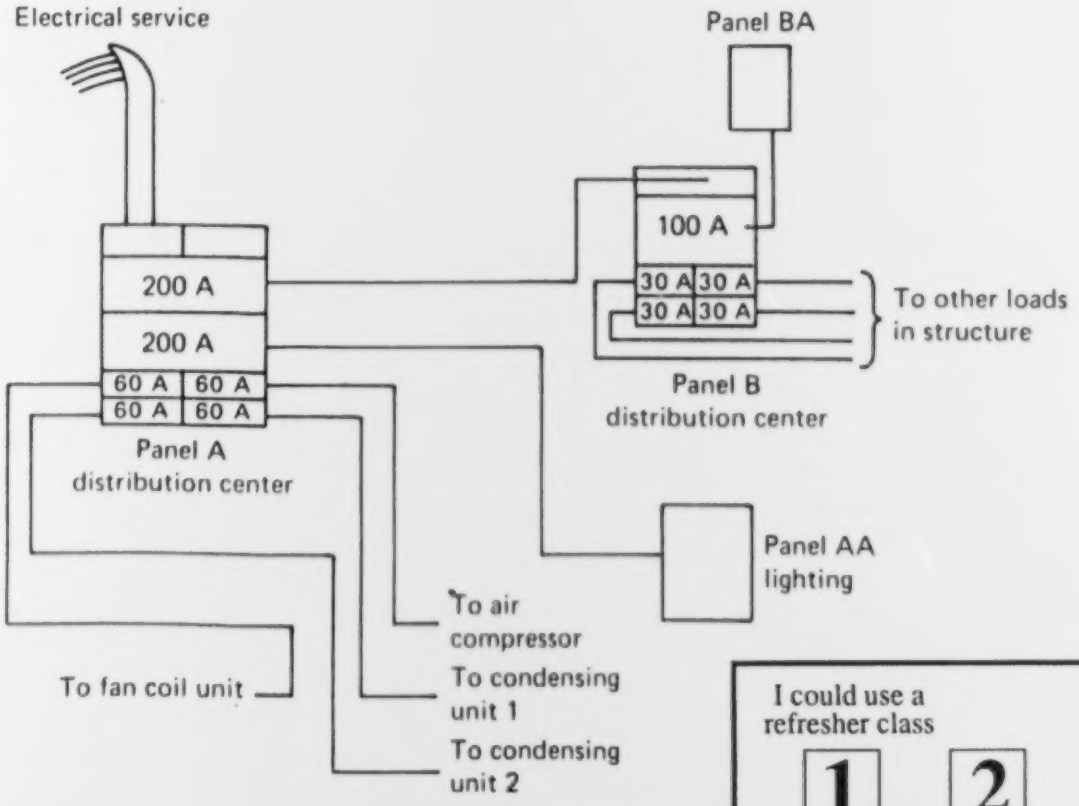
_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Electricity & Electronics

*Below you will find a schematic of an electrical distribution system.*

Identify an electrical distribution system located at Onan and explain its purpose.




I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

Using this diagram, identify and explain the components of an adjustable speed drive from a motor generator.

_____

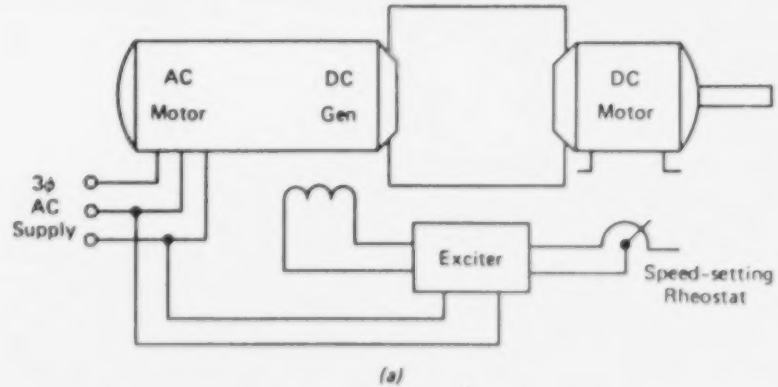
_____

_____

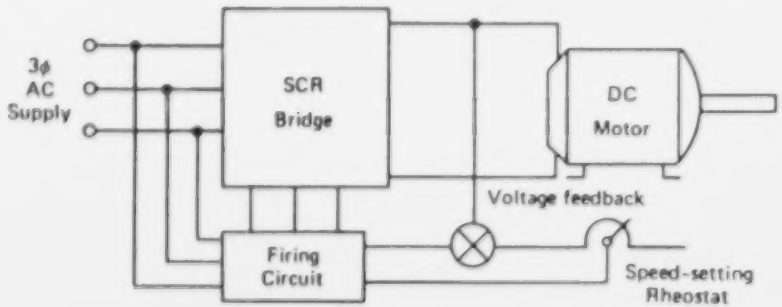
Would you be able to identify the missing control component device terminology on the following page?

Yes

No




(a)




(b)

I could use a refresher class | I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

| Symbol | Device |
|---|---|
| | Ground connection |
| | Fuse |
| | Resistor |
| | Slide wire rheostat |
| | Rheostat |
| IL | Indicating lamp |
| | Capacitor |
| | Diode |
| | Silicon controlled rectifier (SCR) |
| or | Overload heater |
| | Blowout coil |
| or | Operating coil |
| | Contact normally open |
| | Contact normally closed |
| | Spring-return pushbutton normally open |
| | Spring-return pushbutton normally closed |
| | Sustaining type pushbutton |
| | Plug-type contact |
| | Mechanical interlock |
| | Mechanical interlock with fulcrum |

| Symbol | Device |
|---|---|
| | Crossing conductors not connected |
| | Connected conductors |
| | Transformer |
| | Current transformer |
| | Three-pole circuit breaker |
| | Three-pole power breaker for a-c circuits rated in excess of 1500 volts |
| | Switch |
| | Reactor or field winding |
| | Bell, Buzzer, Horn or siren |

Limit switches

| | |
|---|---|
| | Normally open contact |
| | Normally open contact held closed |
| | Normally closed contact |
| | Normally closed contact held open |

29

# Section 3: Mechanical & Machining Skills

# Machining & Mechanics

*What are the drilling machines at Onan designed to do:*

_____

_____

_____

_____

_____

_____

*Describe the major components of a drilling machine:*

Machine Base _____

Work Table _____

Drill Press Table _____

Drive Mechanism _____

Other _____

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Machining & Mechanics

*List the important preventative maintenance strategies for preserving Onan's lathes.* _____

_____

_____

_____

_____

_____

*What functions do lubricants serve and what problems are caused when lubricant levels are not sufficient?*

_____

_____

_____

_____

_____

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Machining & Mechanics

*What are the components of automatic tool machines at Onan?*
*List the single spindle and multiple-spindle ASM components*

_____

_____

_____

_____

_____

*What are some logical troubleshooting steps that you use when working with ASM machines.*

_____

_____

_____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |



75

76

# Machining & Mechanics

*What are the milling machines at Onan designed to do?* _____

_____

_____

_____

*Define the following terms:*

Spindle Speed _____

_____

Feed _____

_____

*How would you maintain the lubricating system on a milling machine?* _____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Machining & Mechanics

*List the important preventative maintenance strategies for preserving Onan's lathes.*

*What functions do lubricants serve and what problems are caused when lubricant levels are not sufficient?*

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Machining & Mechanics

***Hydraulic and Pneumatic Systems***

Define a hydraulic system and identify one within the Onan plant _____

_____

_____

Define a pneumatic system and identify one within the Onan plant _____

_____

_____

How is the speed control regulated on a hydraulic system? _____

_____

How are travel limits determined on a hydraulic system? _____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

***Hydraulic and Pneumatic Systems***

Can you explain how a pneumatic system works? _____

_____

_____

How is air delivered to each pneumatic system at Onan? _____

_____

_____

Explain the differences between electrical, hydraulic and pneumatic systems

_____

_____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |



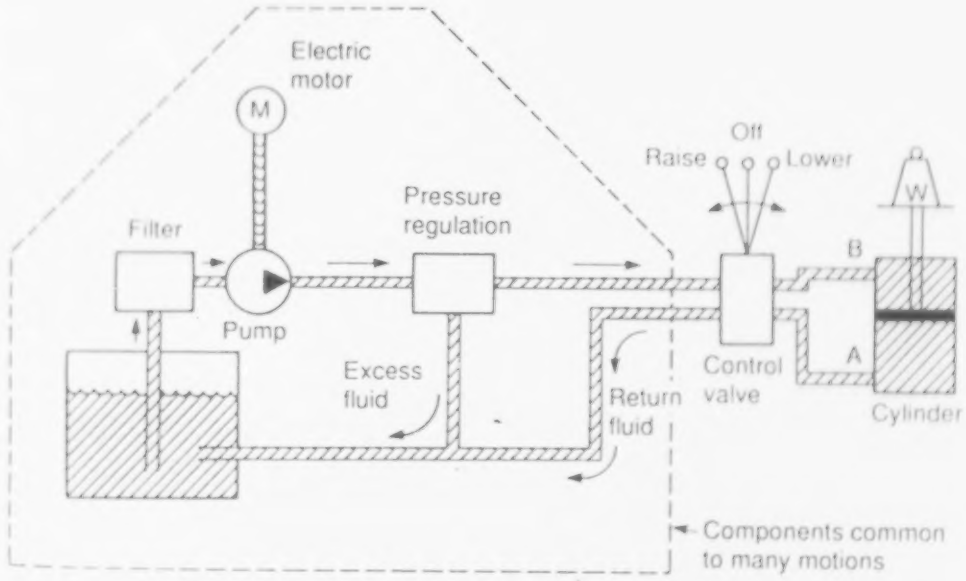
S3 S4

*Do you understand the differences between electrical, hydraulic and pneumatic systems?*

| | *Electrical* | *Hydraulic* | *Pneumatic* |
|---|---|---|---|
| *Energy source* | Usually from outside supplier | Electric motor or diesel driven | Electric motor or diesel driven |
| *Energy storage* | Limited (batteries) | Limited (accumulator) | Good (reservoir) |
| *Distribution system* | Excellent, with minimal loss | Limited, basically a local facility | Good, can be treated as a plant wide service |
| *Energy cost* | Lowest | Medium | Highest |
| *Rotary actuators* | AC & DC motors. Good control on DC motors. AC motors cheap | Low speed. Good control. Can be stalled | Wide speed range. Accurate speed control difficult |
| *Linear actuator* | Short motion via solenoid. Otherwise via mechanical conversion | Cylinders. Very high force | Cylinders. Medium force |
| *Controllable force* | Possible with solenoid & DC motors. Complicated by need for cooling | Controllable high force | Controllable medium force |
| *Points to note* | Danger from electric shock | Leakage dangerous and unsightly. Fire hazard | Noise |

## *Hydraulic and Pneumatic Systems*

Explain the components of this hydraulic system




| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |



S8

S7

# Machining & Mechanics

*Is it estimated that 3/4 of all hydraulic system failures are caused by oil problems. Why is it important to adhere to the following preventative maintenance strategies?*

Regular checks on oil condition and level _____

_____

Checking the oil temperature _____

_____

Checking the filters _____

_____

Checking the motor currents _____

_____

Regular maintenance of actuators _____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

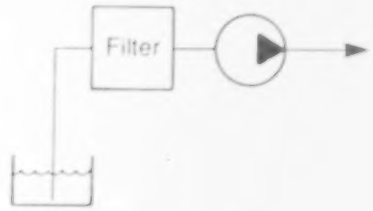
### *Hydraulic and Pneumatic Systems*

What is a positive displacement pump on a hydraulic system? What are the types of positive displacement pumps? _____

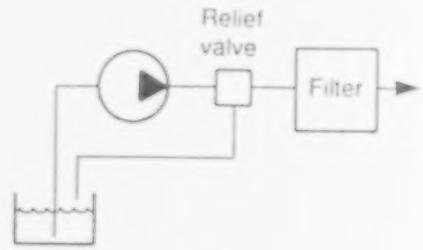
_____

_____

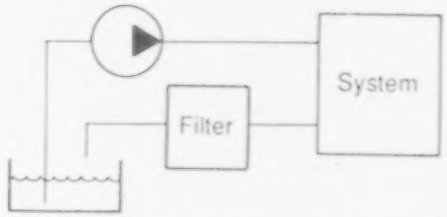
What are the types of filters (filter positions) found in hydraulic systems? Label them below:




(a) Inlet line filter



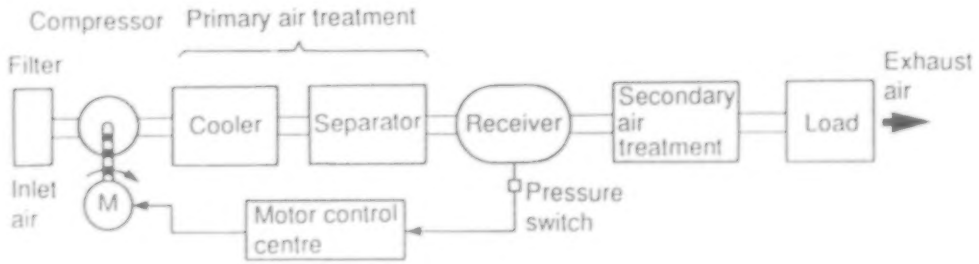

(b) Pressure line filter




(c) Return line filter

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

What are the component parts of a pneumatic system?
Describe the functions of each component below:




| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Machining & Mechanics

*The maintenance of pneumatic systems involves many areas.*
*Why is it important to check the following components?*

Piping _____

_____

Filters _____

_____

Fitting _____

_____

Sequences _____

_____

Validation of safety valve operation on the receiver _____

_____

Replenishment of oil in the air lubrication drainage of water from air dryers _____

_____

_____

I could use a refresher class — I have mastered this area

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

# Machining & Mechanics

*The maintenance of pneumatic systems involves many areas.*
*Why is it important to check the following components on the compressors?*

Belt condition and tension _____

_____

Crankcase oil level _____

_____

Air breather _____

_____

What is the compressor efficiency determined by?

_____

_____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Section 4: Plumbing & HVAC & Welding Skills

# Plumbing

Do you know the standard symbols for plumbing, piping and valves?
Review the following page and complete this box.

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

List the three most basic plumbing systems of a building:

_____

_____

_____


| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

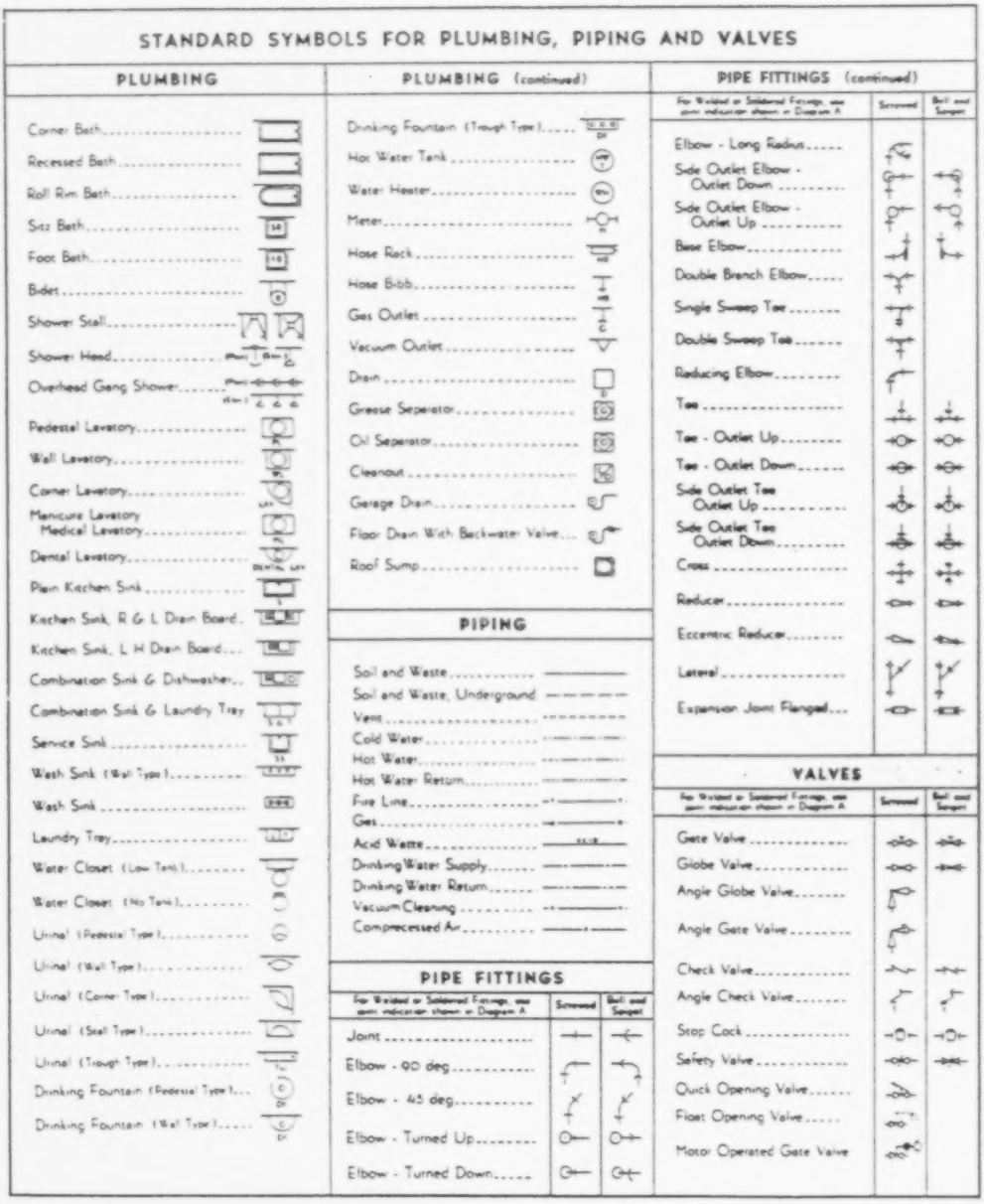



Figure 1-3. Symbols used for plumbing fixtures, piping, fittings, and valves. (American National Standards Institute)





BEST COPY AVAILABLE

# Plumbing

*Define the functions of the following plumbing systems:*

Potable water system

_____

_____

_____

Sanitary drainage and vent piping system

_____

_____

_____

Storm water drainage system

_____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

46

# Plumbing

*Explain where you would use the following materials.*

Cast iron soil pipe and fittings _____

_____

_____

Galvanized steep pipe and fittings _____

_____

_____

Copper tubing with solder joint and flare joint fittings _____

_____

_____

Plastic pipe and fittings _____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Plumbing

*Complete the following questions:*

What are plumbing valves used for? _____

_____

_____

List types of valves that you have installed or maintained _____

_____

_____

Why is it important to understand the thread measurement on pipes and fittings?

_____

_____

_____

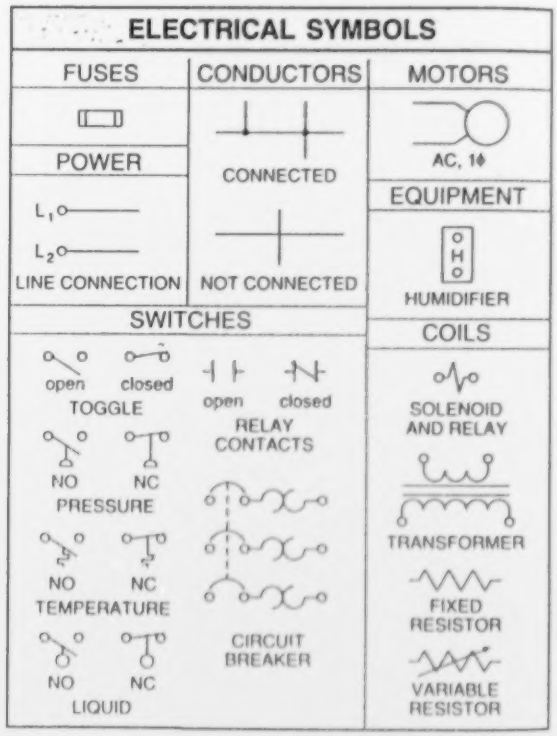
Do you understand the charts located on the next two pages?

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

CHARACTERISTICS OF THE AMERICAN STANDARD TAPER PIPE THREAD (NPT).*

| NOMINAL PIPE SIZE (INCHES) | THREADS PER INCH | APPROXIMATE LENGTH OF THREAD (INCHES) | APPROXIMATE NUMBER OF THREADS TO BE CUT | APPROXIMATE TOTAL THREAD MAKEUP, HAND AND WRENCH (INCHES) |
|---|---|---|---|---|
| 1/8 | 27 | 3/8 | 10 | 1/4 |
| 1/4 | 18 | 5/8 | 11 | 3/8 |
| 3/8 | 18 | 5/8 | 11 | 3/8 |
| 1/2 | 14 | 3/4 | 10 | 7/16 |
| 3/4 | 14 | 3/4 | 10 | 1/2 |
| 1 | 11 1/2 | 7/8 | 10 | 9/16 |
| 1 1/4 | 11 1/2 | 1 | 11 | 9/16 |
| 1 1/2 | 11 1/2 | 1 | 11 | 9/16 |
| 2 | 11 1/2 | 1 | 11 | 5/8 |
| 2 1/2 | 8 | 1 1/2 | 12 | 7/8 |
| 3 | 8 | 1 1/2 | 12 | 1 |
| 3 1/2 | 8 | 1 5/8 | 13 | 1 1/16 |
| 4 | 8 | 1 5/8 | 13 | 1 1/16 |
| 5 | 8 | 1 3/4 | 14 | 1 3/16 |
| 6 | 8 | 1 3/4 | 14 | 1 3/16 |
| 8 | 8 | 1 7/8 | 15 | 1 5/16 |
| 10 | 8 | 2 | 16 | 1 1/2 |
| 12 | 8 | 2 1/8 | 17 | 1 5/8 |

*Dimensions given do not allow for variations in tapping and threading.


ELECTRICAL SYMBOLS
FUSES
POWER
LINE CONNECTION
CONDUCTORS
CONNECTED
NOT CONNECTED
MOTORS
AC, 1ϕ
EQUIPMENT
H
HUMIDIFIER
SWITCHES
open
closed
TOGGLE
open
closed
RELAY CONTACTS
NO
NC
PRESSURE
NO
NC
TEMPERATURE
NO
NC
LIQUID
CIRCUIT BREAKER
COILS
SOLENOID AND RELAY
TRANSFORMER
FIXED RESISTOR
VARIABLE RESISTOR

# HVAC

*Complete the following questions:*

What are the mechanical components of HVAC systems? _____

_____

_____

Explain the chemicals used in HVAC systems _____

_____

_____

What are the components of a forced air heating system?

_____

_____

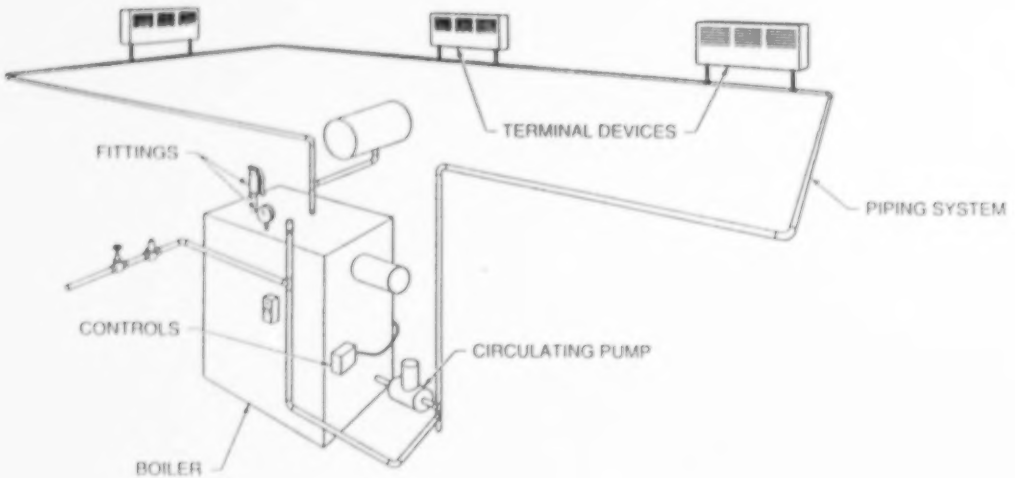
_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# HVAC

*Complete the following questions:*

Explain the components of the hydronic heating system illustrated below




| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# HVAC

*Complete the following questions:*

Explain the difference between a low pressure and a high pressure boiler _____

_____

_____

Define mechanical compression refrigeration _____

_____

_____

Define absorption refrigeration _____

_____

_____

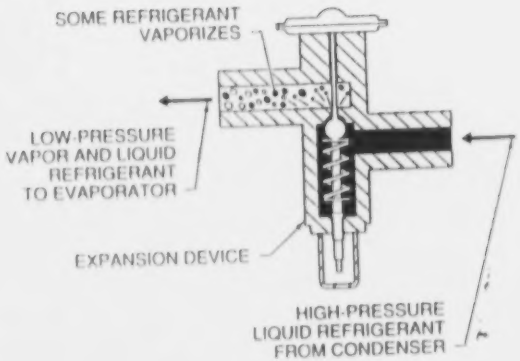
What is the function of the low pressure side of a refrigeration system? _____

_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

What are the functions of the components in the expansion device illustrated below?


SOME REFRIGERANT VAPORIZES
LOW-PRESSURE VAPOR AND LIQUID REFRIGERANT TO EVAPORATOR
EXPANSION DEVICE
HIGH-PRESSURE LIQUID REFRIGERANT FROM CONDENSER

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# HVAC

*Complete the following questions:*

What is the function of the high-pressure side of a mechanical compression refrigeration system? _____

_____

_____

What are the components of a forced air conditioning system?

_____

_____

_____

What are the components of a hydronic air conditioning system?

_____

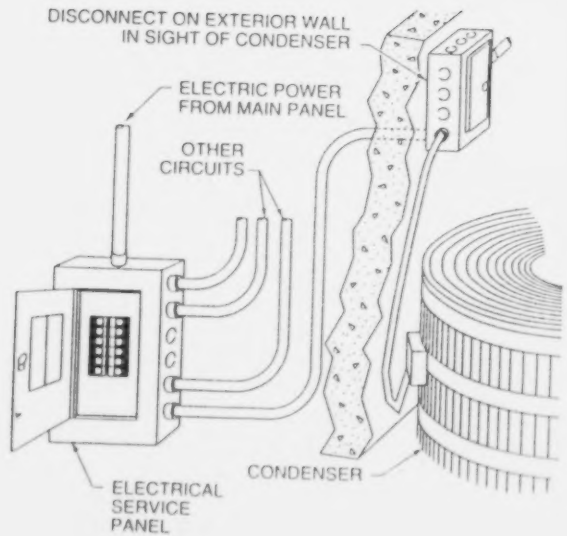
_____

_____

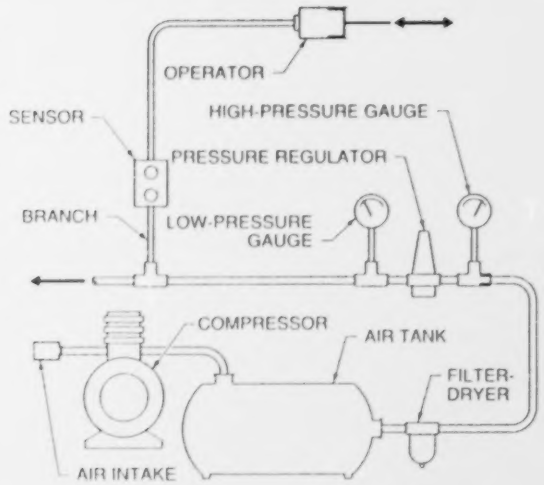
| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# HVAC

Explain the power controls shown below




| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |




Explain the functions of the pneumatic control system illustrated.

I could use a refresher class

1 2 3 4 5

I have mastered this area

# Welding

*Complete the following questions:*

What type of welding process is most pipe welding done in? _____

_____

_____

What are the most common weld processes done at Onan and why are they used?

_____

_____

_____

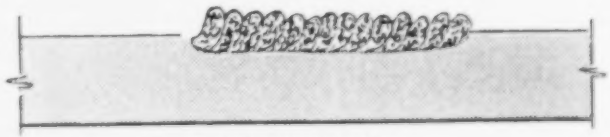
_____

_____

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

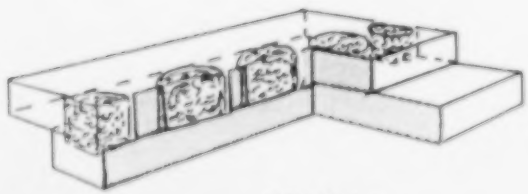
# Welding

Identify the types of welds below and explain where you would use each one.

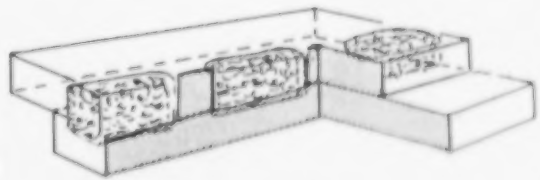


SURFACING WELD

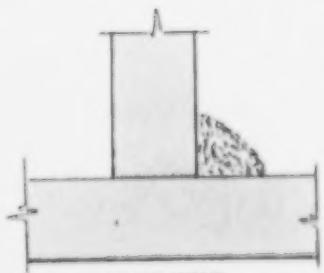
GROOVE WELD



PLUG WELD



SLOT WELD

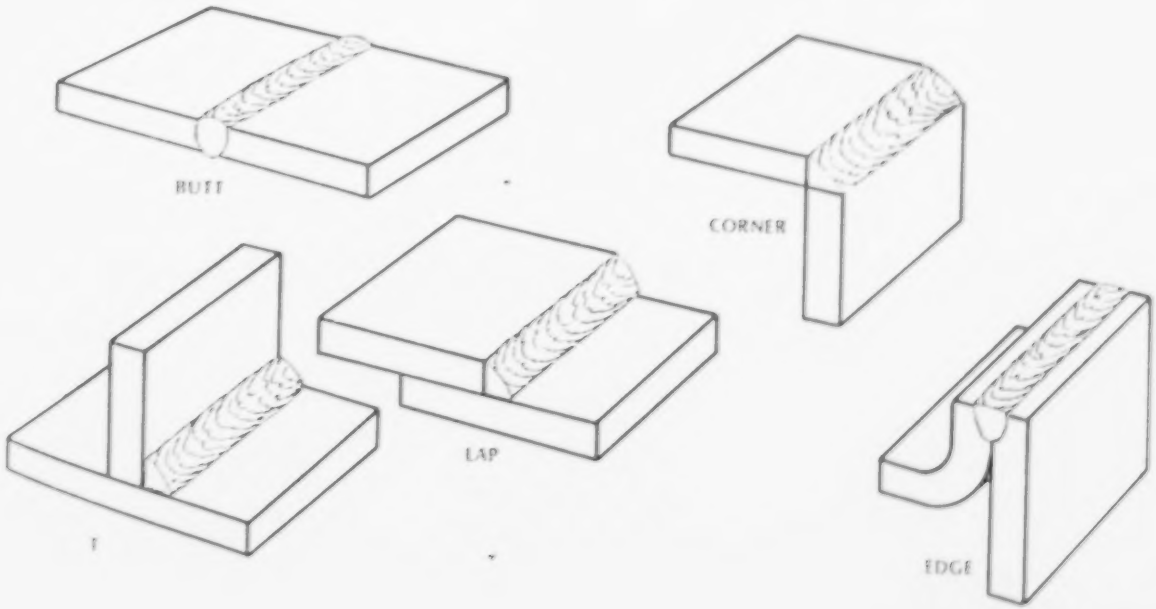


FILLET WELD

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Welding

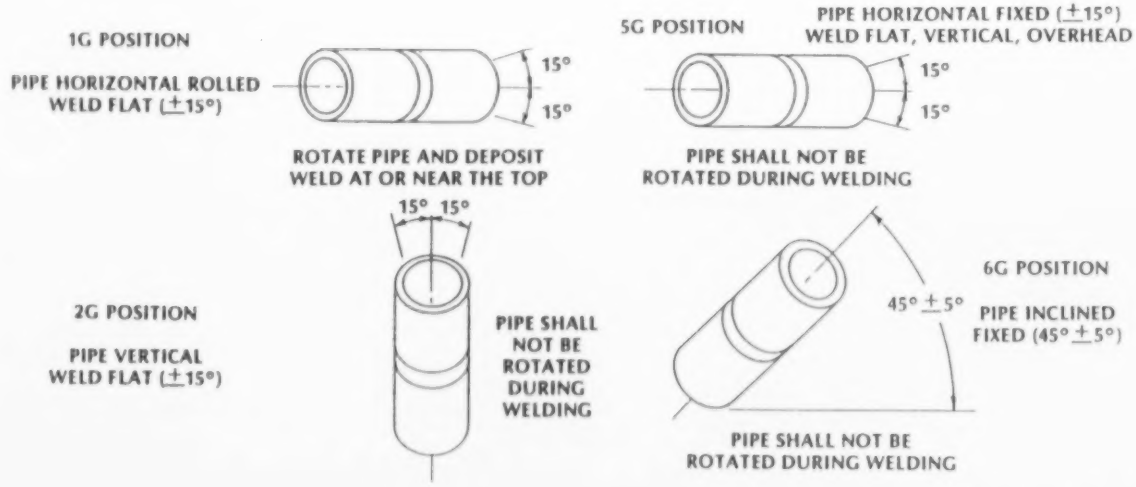
Identify the types of weld joints below and explain where you would use each one.




| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Welding

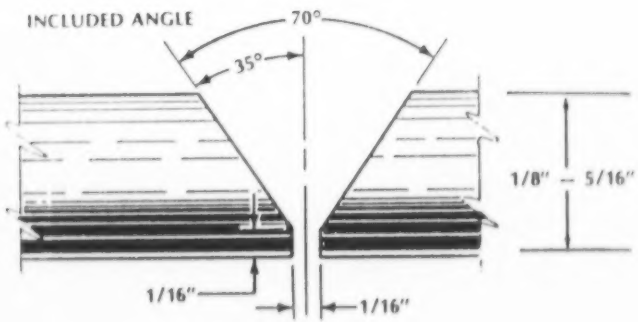
Explain where you have used each of the welding test positions identified below.



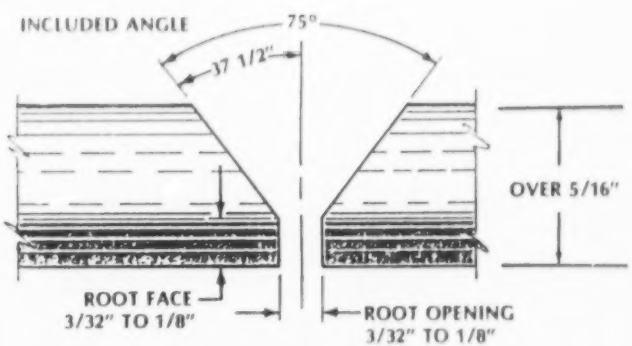

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

# Welding

Why would you weld a thin walled pipe and a thick walled pipe differently?



THIN WALL PIPE



THICK WALL PIPE

| I could use a refresher class | | | | I have mastered this area |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |